sPHENIX HCal Review

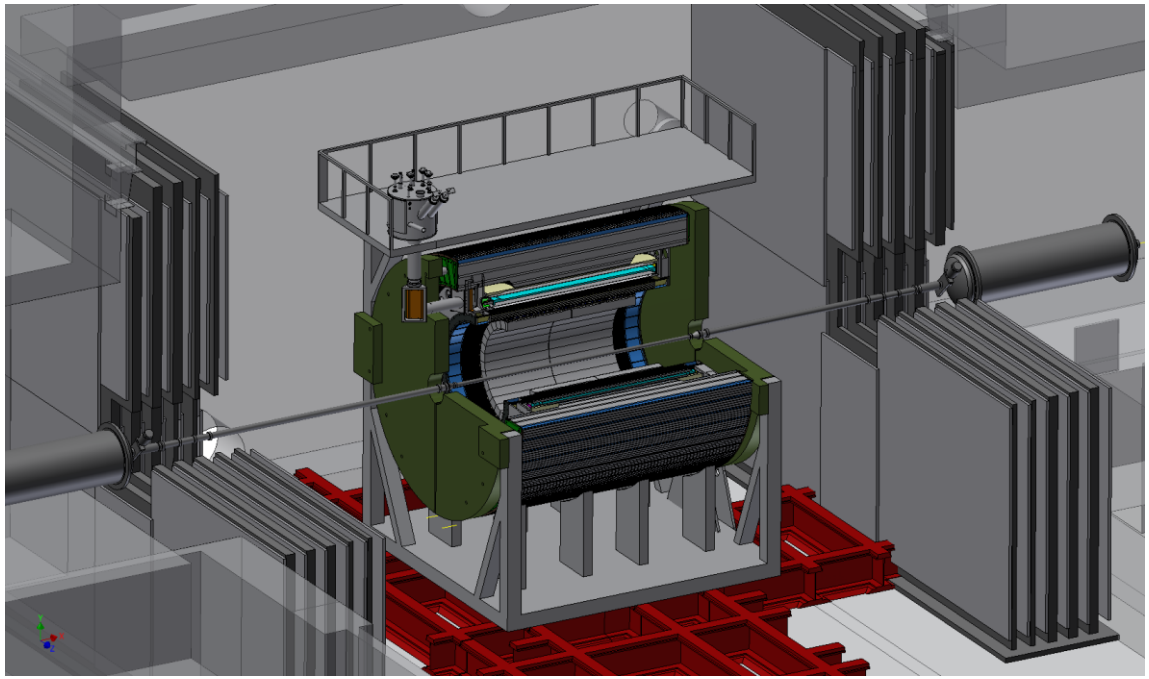
February 23, 2015

Brookhaven National Lab

Review Agenda

1:00	sPHENIX Project/HCal Org & Schedule(15+10)	Ed O'Brien
1:25	HCal Overview(20+10)	John Lajoie
1:55	sPHENIX Mechanics(15+5)	Rich Ruggiero
2:15	HCal Mechanical Design(15+5)	Anatoli Gordeev
2:35	Light Collection and Read Out(20+10)	Edward Kistenev
3:00	HCal Prototyping Plans(10+10)	John Haggerty
3:20	Break	
3:50	Test Beam Results(10+10)	Liang Xue
4:10	Tile Characterization and Testing(10+10)	Jamie Nagle
4:30	Executive session	
5:30	Close Out	

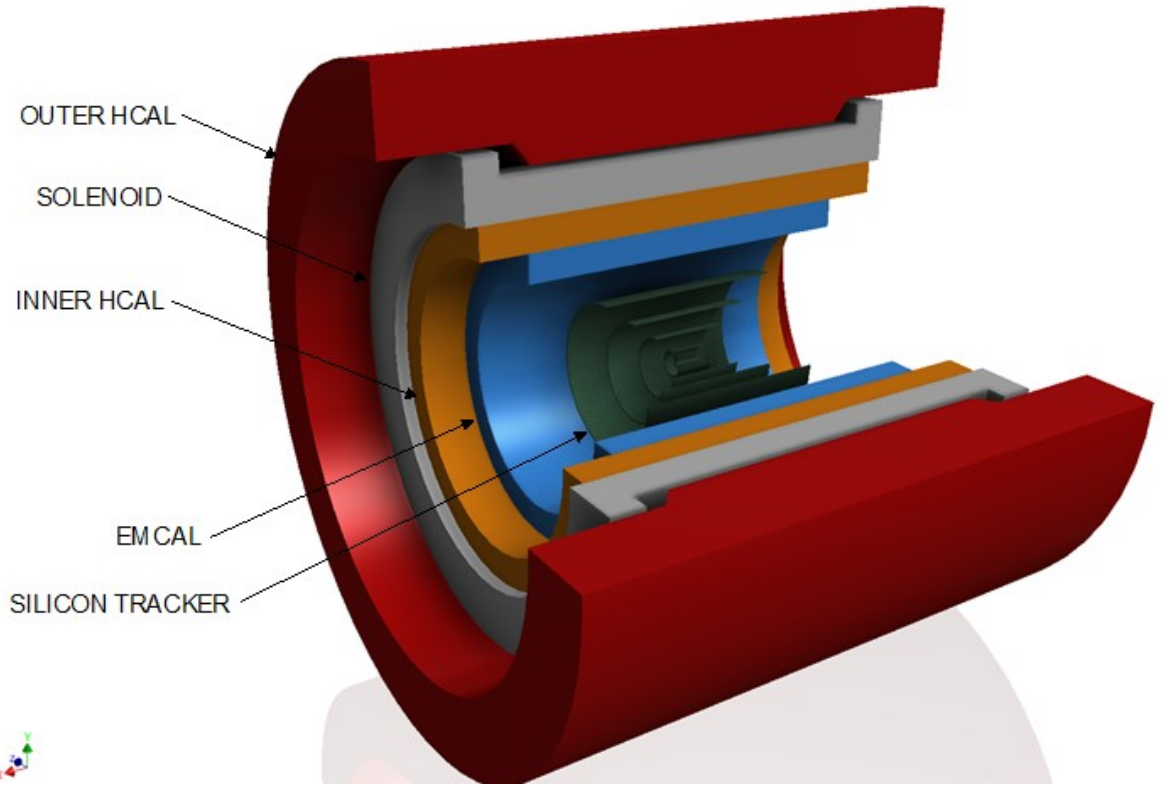
What is sPHENIX?



- **sPHENIX is a major upgrade to PHENIX. It is a new, large-acceptance, high-rate detector for HI physics to be built in the PHENIX hall.**
- **It will be optimized to measure jet and heavy quark physics by incorporating a vertex tracker, full EM and Hadronic Calorimeter coverage at $|\eta| < 1.1$, and a 1.5 T solenoidal magnetic field.**
- **It will utilize most of the infrastructure already existing in the PHENIX detector complex and the BaBar SC-magnet**

sPHENIX Detector and WBS

1.1 Project Management
1.2 Decommissioning
1.3 Magnet
1.4 Tracking
1.5 EM Calorimeter
1.6 Hadronic Calorimeter
1.7 Calorimeter Electronics
1.8 DAQ/Trigger
1.9 Infrastructure
1.10 Integration and Installation



Anticipated sPHENIX Schedule

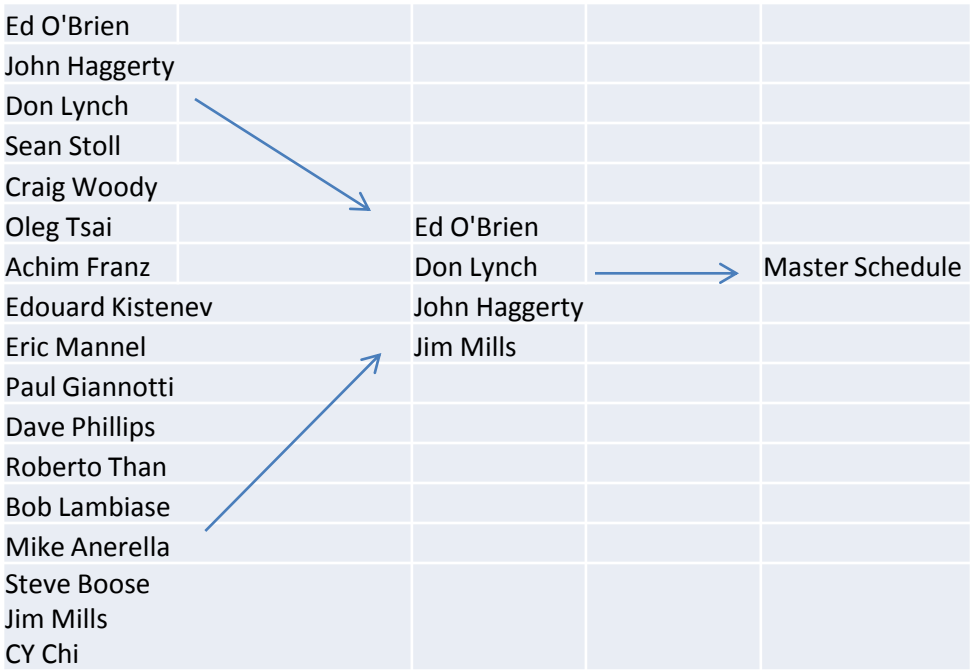
- **Original sPHENIX Proposal submitted to DOE Fall 2012**
- **DOE Science Review July 2014**
- **Revised Proposal Nov 2014**
- **DOE Science Review follow-up scheduled for week of Apr 27, 2015**
- **Expect CD-1 review late spring/summer 2015**
- **CD-1 approval Oct 2015**
- **CD-2/3 approval Oct 2016**
- **Decommissioning of existing PHENIX Detector July 2016 after RHIC Run-16**
- **Procurement of sPHENIX components begins late fall 2016**
- **Installation activities start Sept 2017 and continue through the end of 2020**
- **1st RHIC run with sPHENIX early 2021**

sPHENIX Project Plan Development

- **Bottoms-Up Schedule with Resources and Material Costs assigned each Task.**
  - **Each subsystem expert assigned labor by category, fixed cost and duration**
  - **Used BNL labor bands for costs**
  - **Applied BNL extraordinary construction burden**
- **All tasks are linked to create the schedule**
  - **Critical path goes through the Outer HCal design and construction**
- **Approximately 1000 Tasks in overall schedule.**
- **Prepared fall-2014**
- **Presently being scrubbed and checked by subsystem's reps.**

Project Plan Development

- Schedule/Resource development:



Project Status

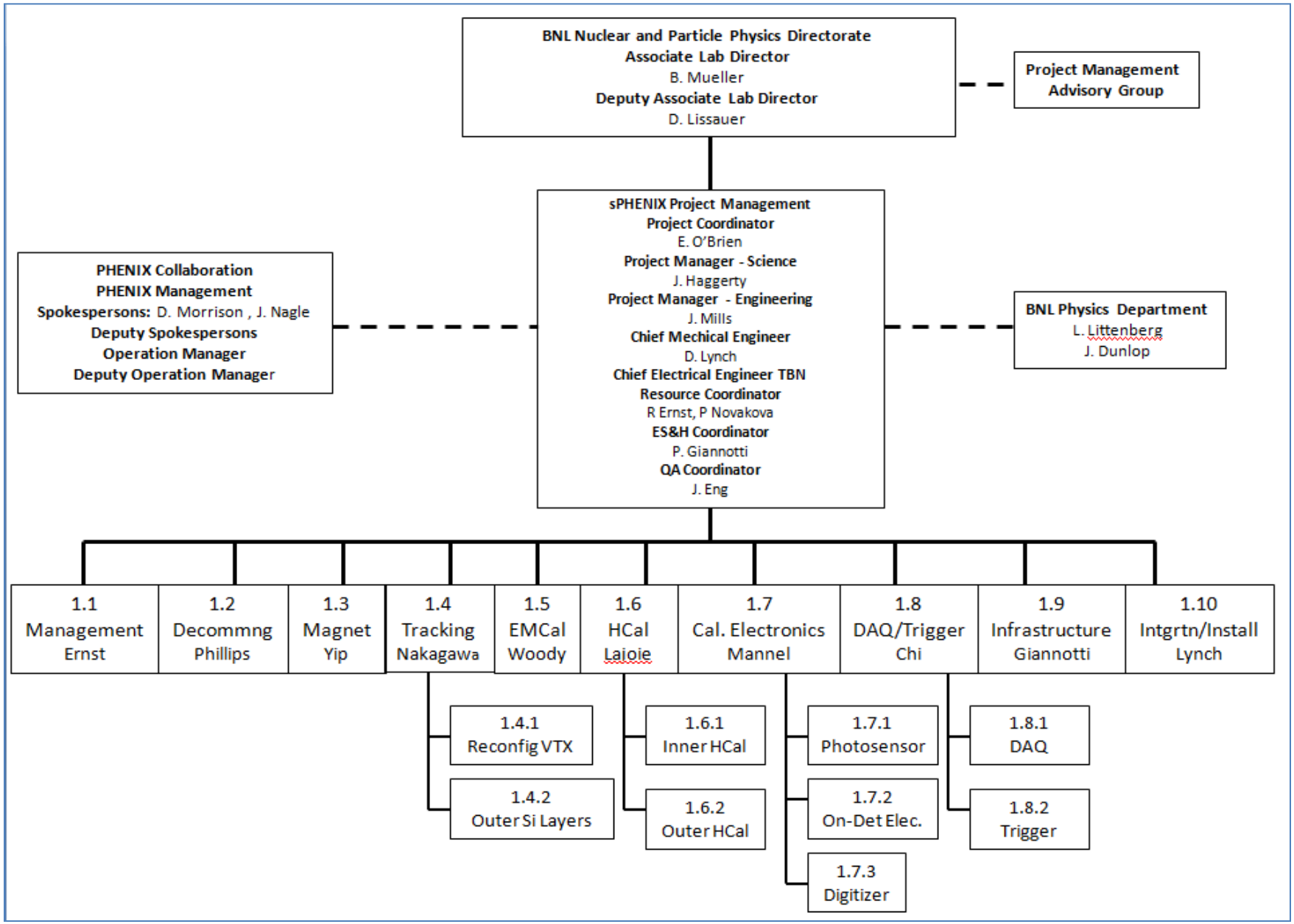
- **Conceptual reference design for much of the detector**
  - **HCal, EMCal, Read Out electronics, DAQ/Trigger are making progress**
  - **Tracker at early stage (2 layers pixels from PHENIX, 5 new strip layers)**
- **Much progress on both physics and detector performance simulations**
  - **See sPHENIX proposal**
- **Working toward CD-1**
  - **WBS structure**
  - **Project file**
  - **Cost estimate**
  - **Labor profile**
- **Cost Estimate yields a Total Project Cost $55-60M fully burdened with 35% contingency**

Documentation for CD-1 Review

- WBS Established by Project team using input from subsystem experts.
- WBS dictionary exist for many WBS categories and should be completed by next week
- People are assigned to produce the various CD-1 documents
- Outline exists for CDR
- Started on the NEPA
- Information for bottoms-up contingency estimate has been collected but not yet completed

- **WBS including Dictionary and Cost Book (Subsystem managers + Proj Controls Manager)**
- **Conceptual Design Report (John H, Ed O'B, Brant Johnson)**
- **Cost, Schedule and Labor estimates (John H, Ed O'B, Don L, Jim M, subsystem managers)**
- **Basis of Estimate documents**
- **Contingency Estimate – Bottoms up and risked based (Ed O'B, Jim M, Proj Controls Manager)**
- **Project Execution Plan (Ed O'B, John H, Jim M)**
- **Safety and Hazard Analysis (Paul Gianotti, Don L, C-AD ES&H)**
- **Quality Assurance Plan (Jack E)**
- **Acquisition Strategy (Penka N)**
- **Risk Analysis and Mitigation document (Jim M, Don L)**
- **National Environmental Policy Act document (Jim M, C-AD ES&H)**
- **Integrated Project Management Team document (JM EO'B)**

The Management Team



The Work Force

~ 30 person PHENIX Operations group

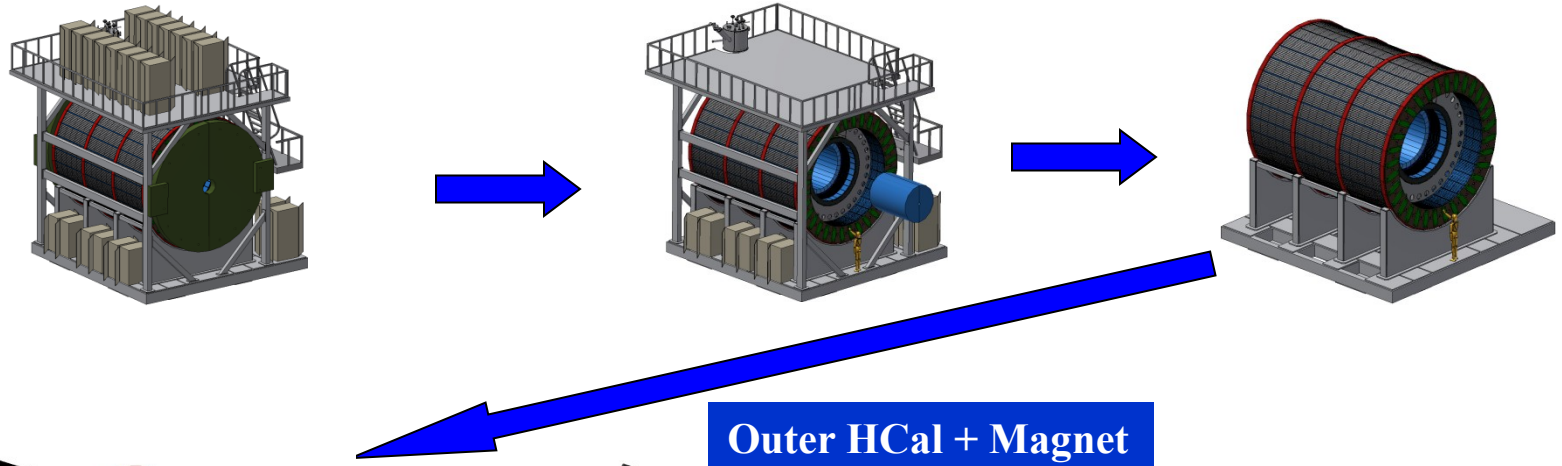
- **Most with > 10 years experience on PHENIX, many on PHENIX 20 years**
- **Appropriate mix of labor due to fact we have added ~$25M of upgrades to PHENIX in the last 10 years**
- **9 Professional, 8.5 Technicians, 1.5 Designers, 10 FTE Scientists (additional 8.5 scientists supported at BNL by NP research funds), 1 Admin**

- **sPHENIX construction also supported by C-AD and SMD especially for the Decommissioning, Magnet and Installation**
- **All students plus additional scientists and postdocs from universities**
- **Additional funds being sought from NSF, Japan, Korea, LDRDs at other national labs.**

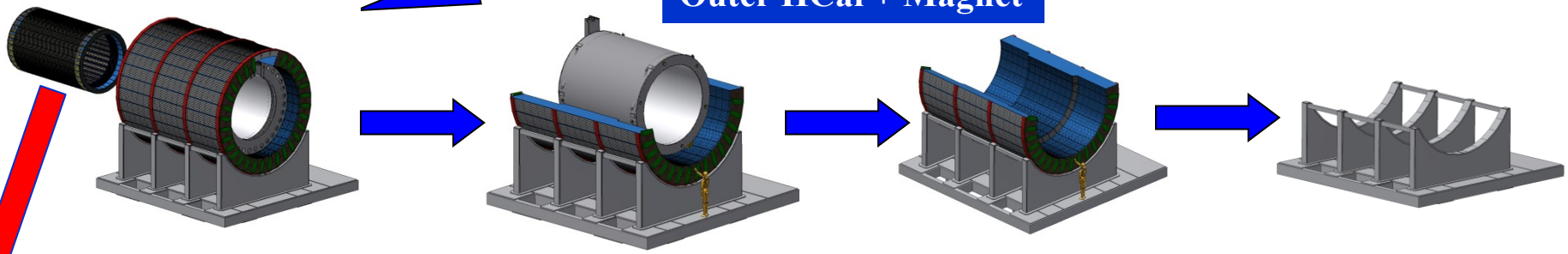
The Assembly Plan

- **Outer HCal modules built at BNL. Installed in PHENIX Assembly Hall**
  - **Need to identify space at BNL for HCal fabrication and testing. We have an area in mind.**
- **Inner HCal modules built at collaborating university**
  - **Shipped to BNL for final testing and installation**
- **EMCal modules built in industry or collaborating universities**
  - **Shipped to BNL for final testing and installation**
- **Tracker staves built in Japan**
  - **Assembly of barrel layers and testing at BNL**
  - **Need to identify space. We have an area in mind.**

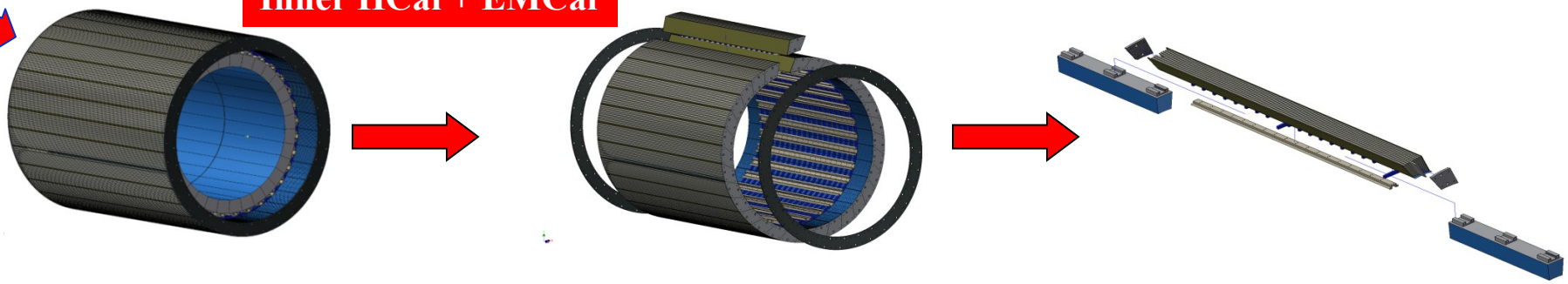
sPHENIX Deconstructed



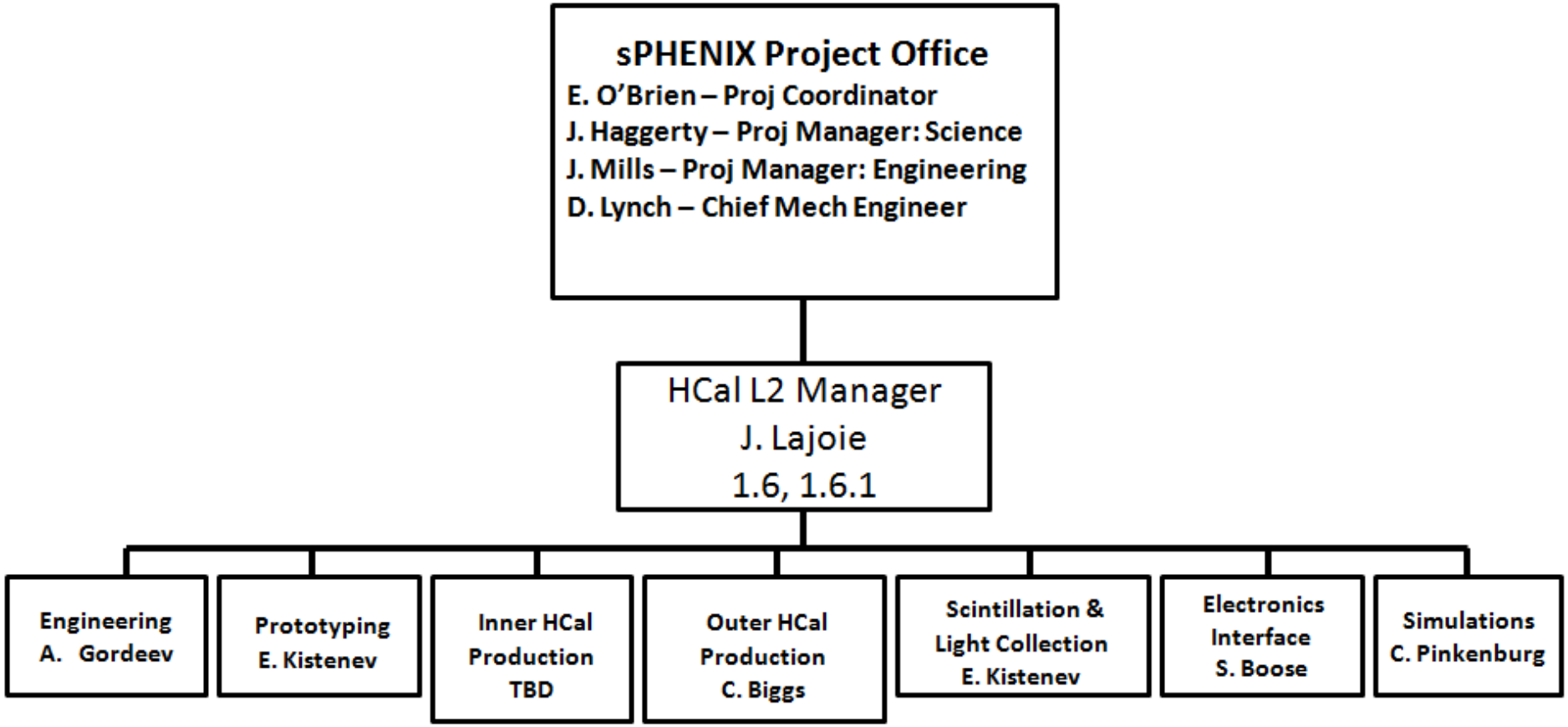
Outer HCal + Magnet



Inner HCal + EMCal

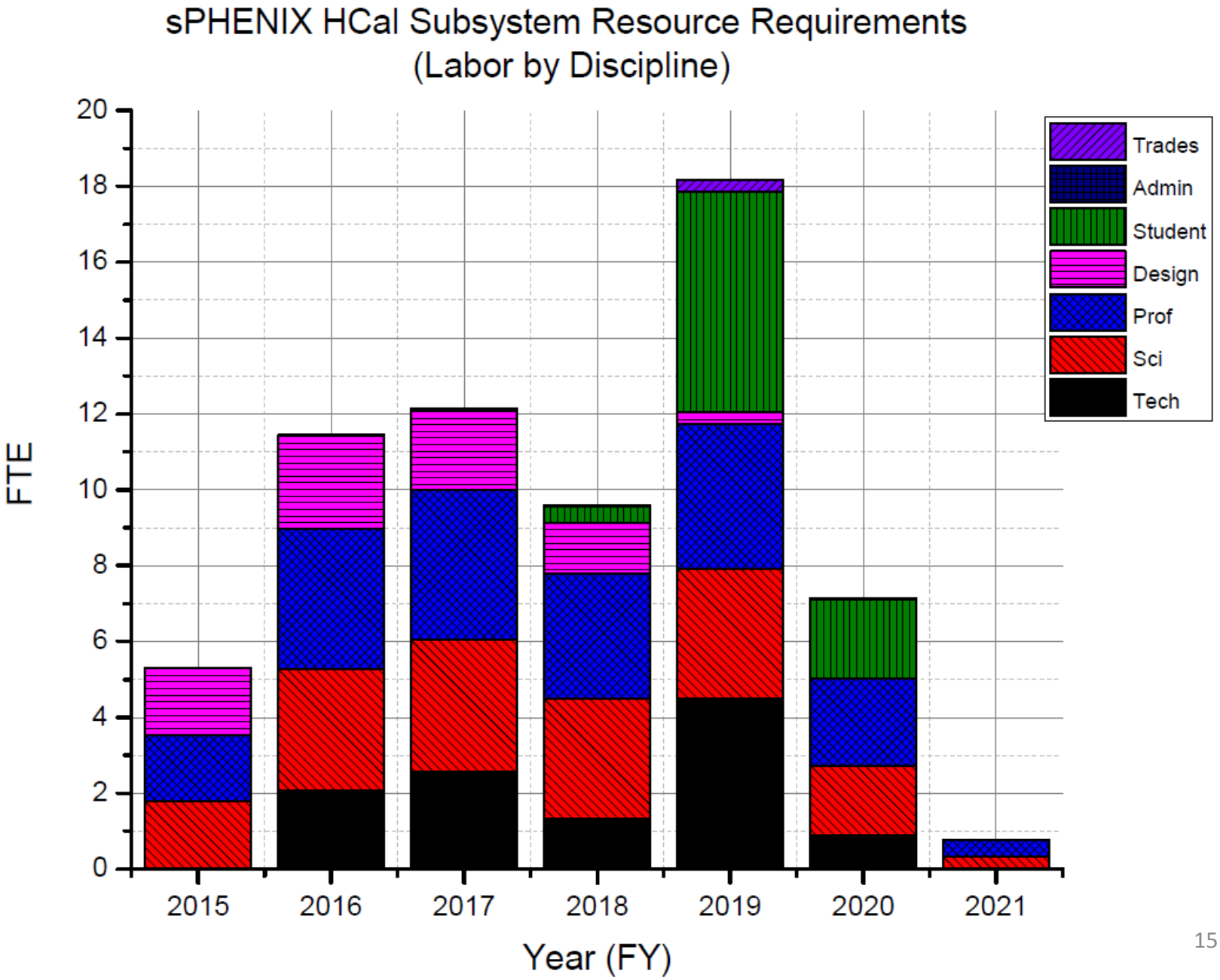


HCal Organization



Note: Calorimeter Electronics is WBS 1.7, Eric Mannel is the L2 manager

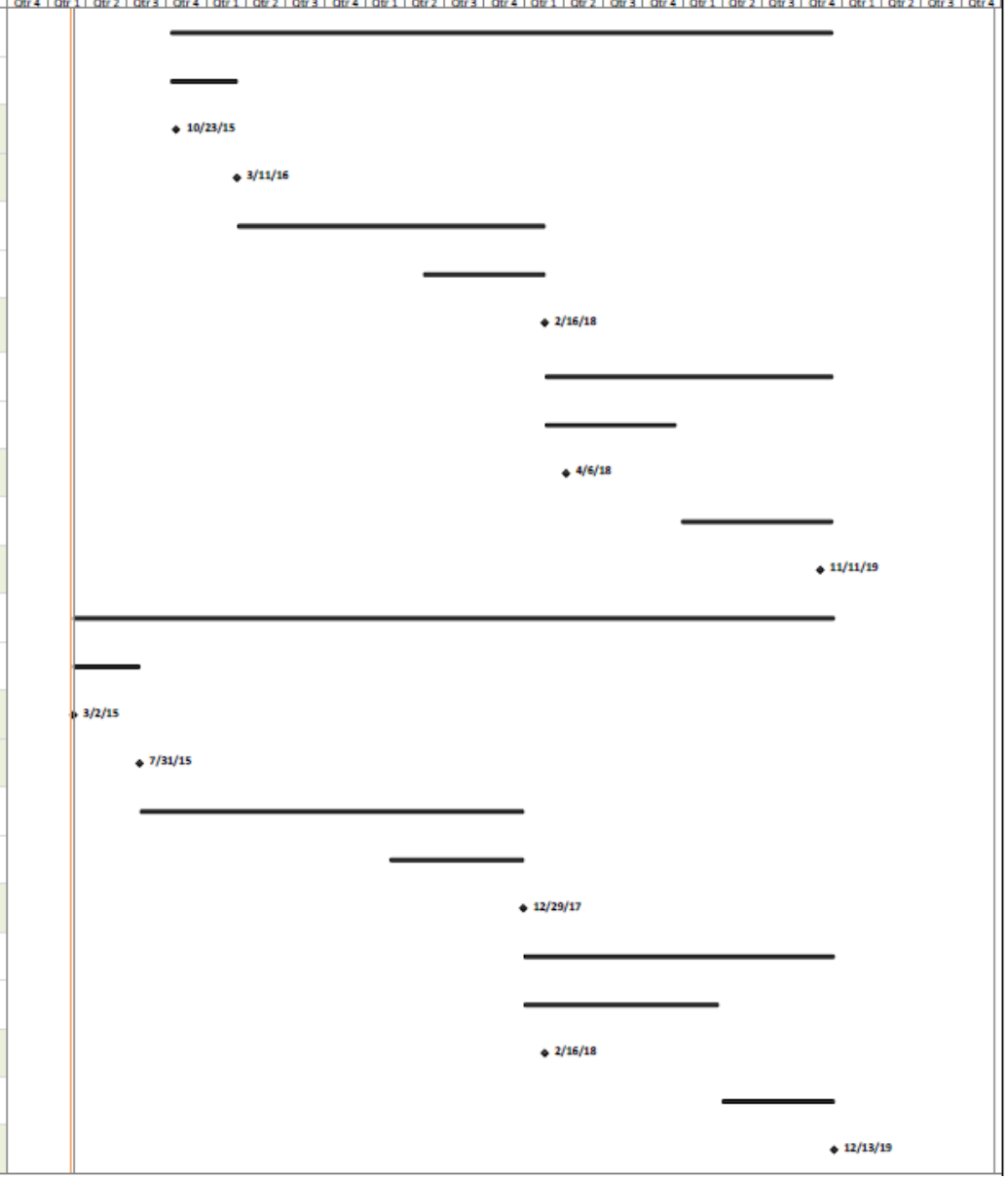
HCal Labor Profile



HCal Schedule and Milestones

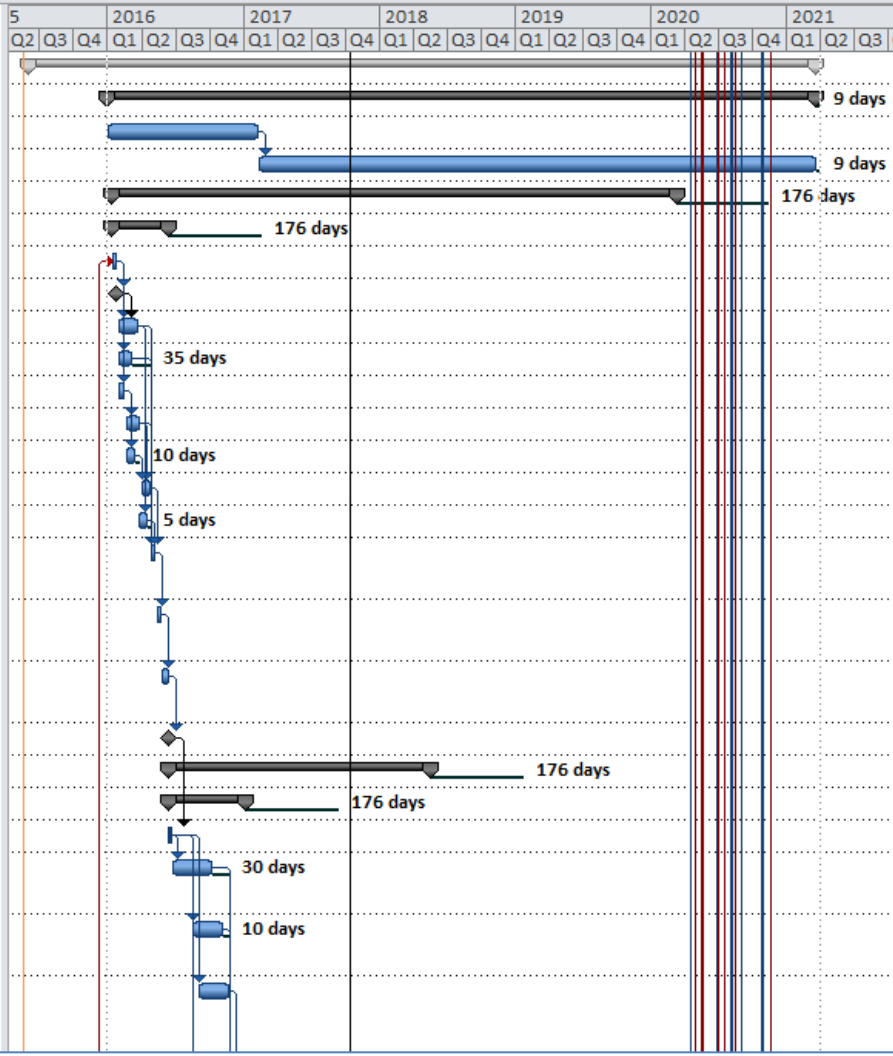
HCal Milestones

ID	Task Name	Duration	Start	Finish	Predecessors
4	Inner HCAL	1086 days	Mon 10/12/15	Mon 12/9/19	
5	Inner HCAL design	110 days	Mon 10/12/15	Fri 3/11/16	
7	Start Inner HCAL Design	0 days	Fri 10/23/15	Fri 10/23/15	6
18	Start Inner HCAL prototype	0 days	Fri 3/11/16	Fri 3/11/16	17
19	Inner HCAL prototype	505 days	Mon 3/14/16	Fri 2/16/18	
38	Inner HCAL preproduction prototype	200 days	Mon 5/15/17	Fri 2/16/18	
47	Complete Inner HCAL Prototype and Start Production	0 days	Fri 2/16/18	Fri 2/16/18	46
48	Inner HCAL production	471 days	Mon 2/19/18	Mon 12/9/19	
49	Inner HCAL module production	215 days	Mon 2/19/18	Fri 12/14/18	
52	Design Complete Inner HCAL	0 days	Fri 4/6/18	Fri 4/6/18	51
63	Inner HCAL module testing/calibration/integration	246 days	Fri 12/28/18	Mon 12/9/19	
68	Inner HCAL Ready for Installation	0 days	Mon 11/11/19	Mon 11/11/19	67
71	Outer HCAL	1250 days	Mon 3/2/15	Fri 12/13/19	
72	Outer HCAL Conceptual design	110 days	Mon 3/2/15	Fri 7/31/15	
73	Start Outer HCAL Design	0 days	Mon 3/2/15	Mon 3/2/15	
85	Start Outer HCAL prototype	0 days	Fri 7/31/15	Fri 7/31/15	84
86	Outer HCAL prototype	630 days	Mon 8/3/15	Fri 12/29/17	
105	Outer HCAL preproduction prototype	220 days	Mon 2/27/17	Fri 12/29/17	
114	Compete Outer HCAL Prototype Work	0 days	Fri 12/29/17	Fri 12/29/17	113
115	Outer HCAL production	510 days	Mon 1/1/18	Fri 12/13/19	
116	Outer HCAL module production	320 days	Mon 1/1/18	Fri 3/22/19	
119	Outer HCAL Design Complete	0 days	Fri 2/16/18	Fri 2/16/18	118
130	Outer HCAL module testing/calibration/integration	185 days	Mon 4/1/19	Fri 12/13/19	
135	Outer HCAL Ready for Installation	0 days	Fri 12/13/19	Fri 12/13/19	134



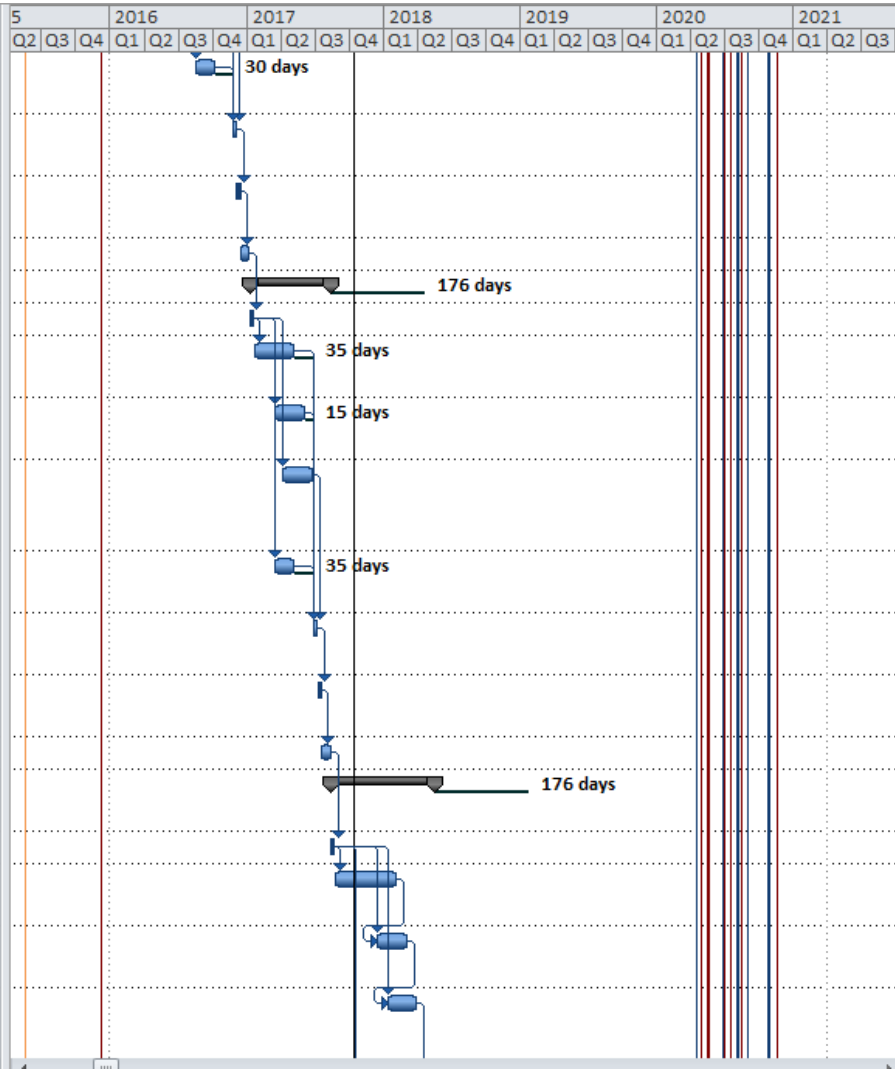
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
7	**1.6**	**hcal_v3**	**1513 days**	**Mon 3/2/15**	**Wed 12/16/20**
1	**1.6.1**	**HCAL management**	**1360 days**	**Thu 10/1/15**	**Wed 12/16/20**
2	1.6.1.4	Prepare for CD2/3 review	290 days	Thu 10/1/15	Wed 11/9/16
3	1.6.1.5	Manage Project	1070 days	Thu 11/10/16	Wed 12/16/20
4	**1.6.2**	**Inner HCAL**	**1086 days**	**Mon 10/12/15**	**Mon 12/9/19**
5	**1.6.2.1**	**Inner HCAL design**	**110 days**	**Mon 10/12/15**	**Fri 3/11/16**
6	1.6.2.1.1	Specify configuration	10 days	Mon 10/12/15	Fri 10/23/15
7	1.6.2.1.13	Start Inner HCAL Design	0 days	Fri 10/23/15	Fri 10/23/15
8	1.6.2.1.2	Design absorber	40 days	Mon 10/26/15	Fri 12/18/15
9	1.6.2.1.3	Design module hardware	30 days	Mon 10/26/15	Fri 12/4/15
10	1.6.2.1.4	Specify scintillator tiles	15 days	Mon 10/26/15	Fri 11/13/15
11	1.6.2.1.5	Design scintillator tiles	30 days	Mon 11/16/15	Fri 12/25/15
12	1.6.2.1.6	Specify light collector	20 days	Mon 11/16/15	Fri 12/11/15
13	1.6.2.1.7	Design light collector	20 days	Mon 12/28/15	Fri 1/22/16
14	1.6.2.1.8	Design lifting fixtures	20 days	Mon 12/21/15	Fri 1/15/16
15	1.6.2.1.9	Create top level assembly drawings	10 days	Mon 1/25/16	Fri 2/5/16
16	1.6.2.1.10	Preparation for internal reviews	10 days	Mon 2/8/16	Fri 2/19/16
17	1.6.2.1.11	Preparation for external review	15 days	Mon 2/22/16	Fri 3/11/16
18	1.6.2.1.12	Start Inner HCAL prototype	0 days	Fri 3/11/16	Fri 3/11/16
19	**1.6.2.2**	**Inner HCAL prototype**	**505 days**	**Mon 3/14/16**	**Fri 2/16/18**
20	**1.6.2.2.1**	**Inner HCAL prototype v1**	**150 days**	**Mon 3/14/16**	**Fri 10/7/16**
21	1.6.2.2.1.1	Specify configuration	5 days	Mon 3/14/16	Fri 3/18/16
22	1.6.2.2.1.2	Design, procure, asemble absorber	80 days	Mon 3/21/16	Fri 7/8/16
23	1.6.2.2.1.3	Design, procure, asemble scintillator tiles	60 days	Mon 5/16/16	Fri 8/5/16
24	1.6.2.2.1.4	Design, procure, assemble light collection and light tighting	60 days	Mon 5/30/16	Fri 8/19/16



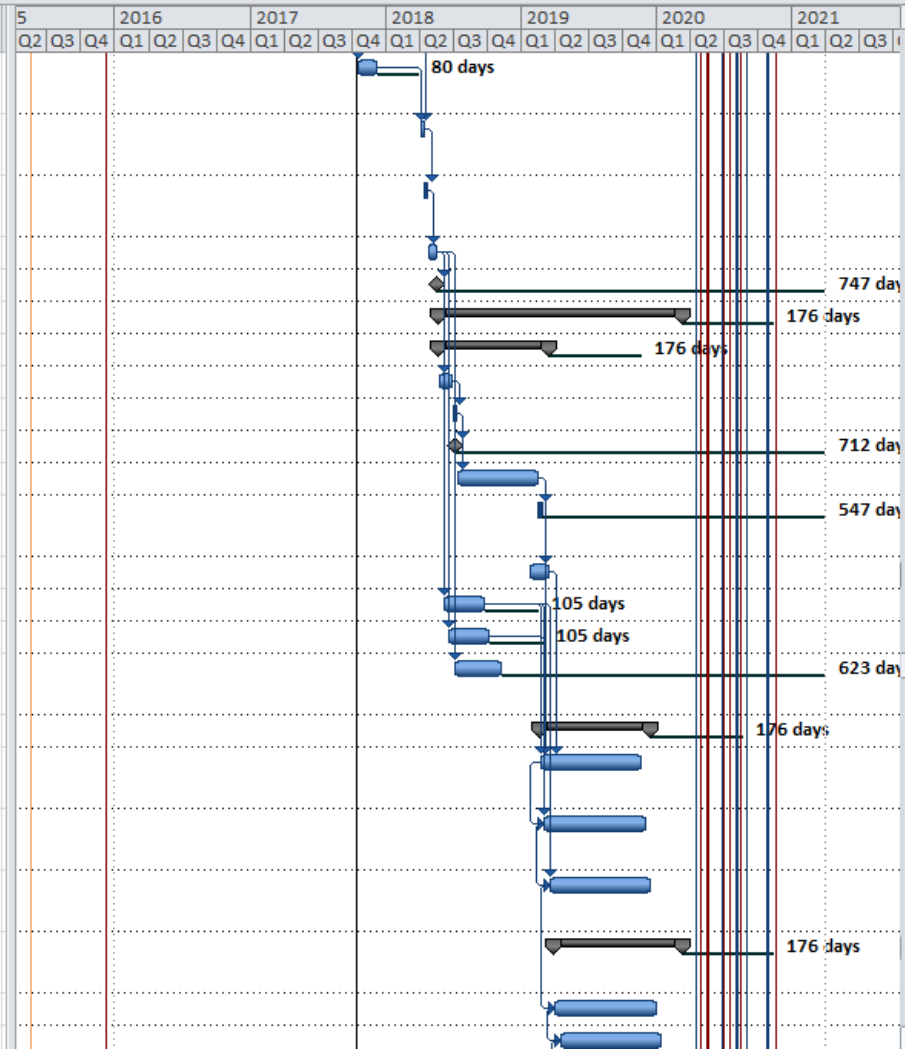
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
25	1.6.2.2.1.5	Design, procure, assemble stand	40 days	Mon 5/16/16	Fri 7/8/16
26	1.6.2.2.1.6	Integrate and test with electronics	10 days	Mon 8/22/16	Fri 9/2/16
27	1.6.2.2.1.7	Prepare and transport to test beam	5 days	Mon 9/5/16	Fri 9/9/16
28	1.6.2.2.1.8	Test beam operation	20 days	Mon 9/12/16	Fri 10/7/16
29	**1.6.2.2.2**	**Inner HCAL prototype v2**	**155 days**	**Mon 10/10/16**	**Fri 5/12/17**
30	1.6.2.2.2.1	Specify configuration	5 days	Mon 10/10/16	Fri 10/14/16
31	1.6.2.2.2.2	Design, procure, assemble absorber	80 days	Mon 10/17/16	Fri 2/3/17
32	1.6.2.2.2.3	Design, procure, asemble scintillator tiles	60 days	Mon 12/12/16	Fri 3/3/17
33	1.6.2.2.2.4	Design, procure, assemble light collection and light tighting	60 days	Mon 1/2/17	Fri 3/24/17
34	1.6.2.2.2.5	Design, procure, assemble stand	40 days	Mon 12/12/16	Fri 2/3/17
35	1.6.2.2.2.6	Integrate and test with electronics	10 days	Mon 3/27/17	Fri 4/7/17
36	1.6.2.2.2.7	Prepare and transport to test beam	5 days	Mon 4/10/17	Fri 4/14/17
37	1.6.2.2.2.8	Test beam operation	20 days	Mon 4/17/17	Fri 5/12/17
38	**1.6.2.2.3**	**Inner HCAL preproduction prototype**	**200 days**	**Mon 5/15/17**	**Fri 2/16/18**
39	1.6.2.2.3.1	Specify configuration	5 days	Mon 5/15/17	Fri 5/19/17
40	1.6.2.2.3.2	Design, procure, assemble absorber	120 days	Mon 5/22/17	Fri 11/3/17
41	1.6.2.2.3.3	Design, procure, asemble scintillator tiles	60 days	Mon 9/11/17	Fri 12/1/17
42	1.6.2.2.3.4	Design, procure, assemble light collection and light	60 days	Mon 10/9/17	Fri 12/29/17



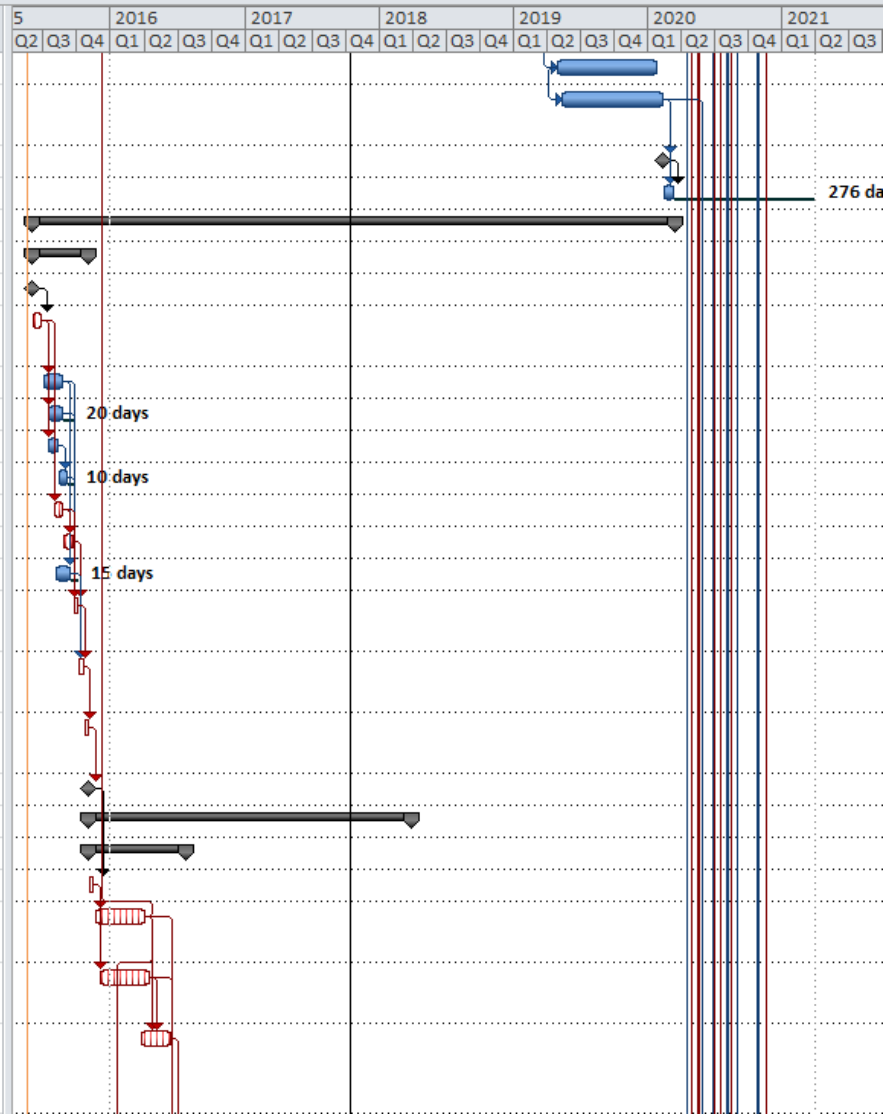
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
43	1.6.2.2.3.5	Design, procure, assemble stand	40 days	Mon 7/17/17	Fri 9/8/17
44	1.6.2.2.3.6	Integrate and test with electronics	10 days	Mon 1/1/18	Fri 1/12/18
45	1.6.2.2.3.7	Prepare and transport to test beam	5 days	Mon 1/15/18	Fri 1/19/18
46	1.6.2.2.3.8	Test beam operation	20 days	Mon 1/22/18	Fri 2/16/18
47	1.6.2.2.3.9	Complete Inner HCAL Protc	0 days	Fri 2/16/18	Fri 2/16/18
48	**1.6.2.3**	**Inner HCAL production**	**471 days**	**Mon 2/19/18**	**Mon 12/9/19**
49	**1.6.2.3.1**	**Inner HCAL module productior**	**215 days**	**Mon 2/19/18**	**Fri 12/14/18**
50	1.6.2.3.1.7	Inner HCAL Final Design	30 days	Mon 2/19/18	Fri 3/30/18
51	1.6.2.3.1.8	Hcal Design Review	5 days	Mon 4/2/18	Fri 4/6/18
52	1.6.2.3.1.9	Design Complete Inner HCA	0 days	Fri 4/6/18	Fri 4/6/18
53	1.6.2.3.1.1	Procure absorber	160 days	Mon 4/9/18	Fri 11/16/18
54	1.6.2.3.1.2	Prepare factory and storage area	5 days	Fri 11/16/18	Fri 11/23/18
55	1.6.2.3.1.3	Receive absorber	40 days	Mon 10/22/18	Fri 12/14/18
56	1.6.2.3.1.4	Procure module hardware	80 days	Fri 3/2/18	Fri 6/22/18
57	1.6.2.3.1.5	Procure scintillator tiles	80 days	Fri 3/16/18	Fri 7/6/18
58	1.6.2.3.1.6	Procure light collector components	94 days	Mon 4/2/18	Thu 8/9/18
59	**1.6.2.3.2**	**Inner HCAL module assembly**	**216 days**	**Mon 11/19/18**	**Mon 9/16/19**
60	1.6.2.3.2.1	Absorber stacking (station 1)	196 days	Mon 11/19/18	Mon 8/19/19
61	1.6.2.3.2.2	Scintillator installation (station 2)	196 days	Fri 11/30/18	Mon 9/2/19
62	1.6.2.3.2.3	Electronics and light tighting (station 3)	196 days	Fri 12/14/18	Mon 9/16/19
63	**1.6.2.3.3**	**Inner HCAL module testing/calibration/integratior**	**246 days**	**Fri 12/28/18**	**Mon 12/9/19**
64	1.6.2.3.3.1	Electronics and sensor test	196 days	Fri 12/28/18	Mon 9/30/19
65	1.6.2.3.3.2	Light pulser/calibration	196 days	Fri 1/11/19	Mon 10/14/19



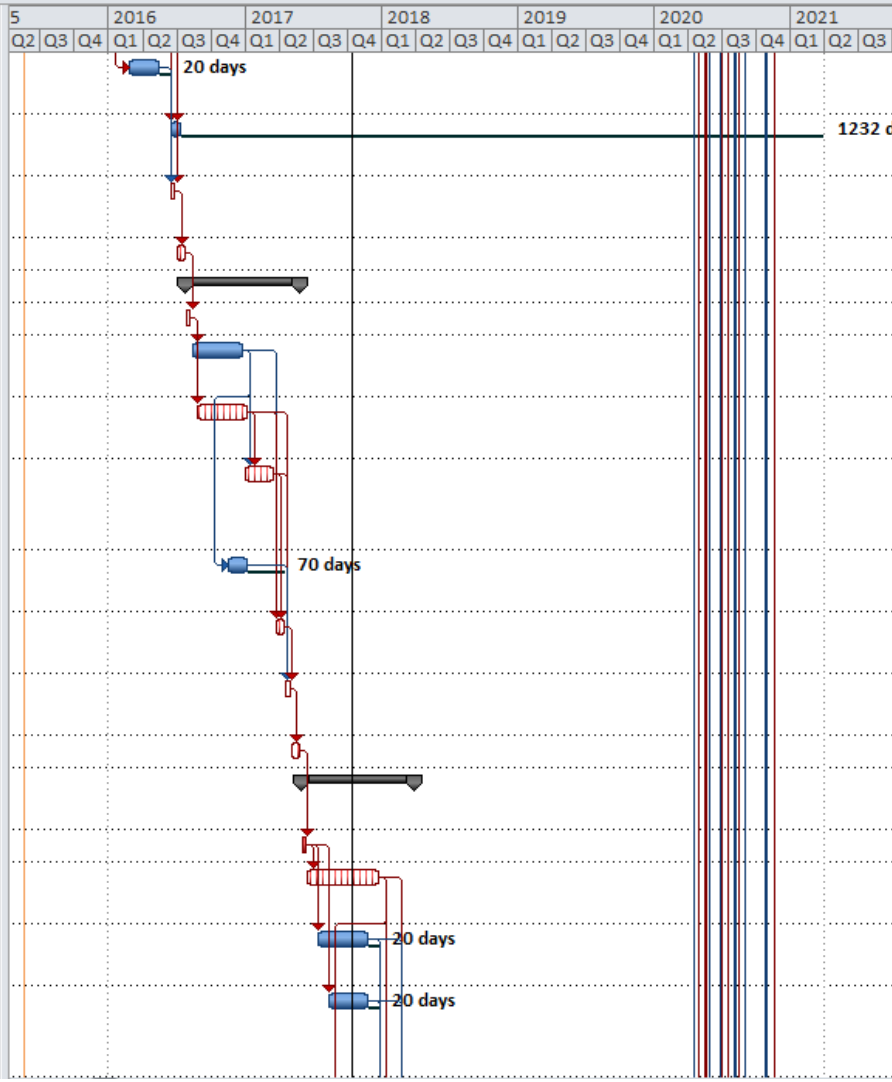
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
66	1.6.2.3.3.3	Cosmic ray/source test	196 days	Fri 1/25/19	Mon 10/28/19
67	1.6.2.3.3.4	Prep module for transportation to 1008	196 days	Fri 2/8/19	Mon 11/11/19
68	1.6.2.3.3.6	Inner HCAL Ready for Install	0 days	Mon 11/11/19	Mon 11/11/19
70	1.6.2.3.3.5	Disassembe Factory	20 days	Tue 11/12/19	Mon 12/9/19
71	**1.6.3**	**Outer HCAL**	**1250 days**	**Mon 3/2/15**	**Fri 12/13/19**
72	**1.6.3.1**	**Outer HCAL Conceptual design**	**110 days**	**Mon 3/2/15**	**Fri 7/31/15**
73	1.6.3.1.13	Start Outer HCAL Design	0 days	Mon 3/2/15	Mon 3/2/15
74	1.6.3.1.1	Specify configuration	20 days	Mon 3/2/15	Fri 3/27/15
75	1.6.3.1.2	Design absorber	40 days	Mon 3/30/15	Fri 5/22/15
76	1.6.3.1.3	Design module hardware	30 days	Mon 4/13/15	Fri 5/22/15
77	1.6.3.1.4	Specify scintillator tiles	20 days	Mon 4/13/15	Fri 5/8/15
78	1.6.3.1.5	Design scintillator tiles	20 days	Mon 5/11/15	Fri 6/5/15
79	1.6.3.1.6	Specify light collector	20 days	Mon 4/27/15	Fri 5/22/15
80	1.6.3.1.7	Design light collector	20 days	Mon 5/25/15	Fri 6/19/15
81	1.6.3.1.8	Design lifting fixtures	30 days	Mon 5/4/15	Fri 6/12/15
82	1.6.3.1.9	Create top level assembly drawings	10 days	Mon 6/22/15	Fri 7/3/15
83	1.6.3.1.10	Preparation for internal reviews and Review	10 days	Mon 7/6/15	Fri 7/17/15
84	1.6.3.1.11	Preparation for external review and Review	10 days	Mon 7/20/15	Fri 7/31/15
85	1.6.3.1.12	Start Outer HCAL prototype	0 days	Fri 7/31/15	Fri 7/31/15
86	**1.6.3.2**	**Outer HCAL prototype**	**630 days**	**Mon 8/3/15**	**Fri 12/29/17**
87	**1.6.3.2.1**	**Outer HCAL prototype v1**	**190 days**	**Mon 8/3/15**	**Fri 4/22/16**
88	1.6.3.2.1.1	Specify configuration	10 days	Mon 8/3/15	Fri 8/14/15
89	1.6.3.2.1.2	Design, procure, asemble absorber	100 days	Mon 8/17/15	Fri 1/1/16
90	1.6.3.2.1.3	Design, procure, asemble scintillator tiles	100 days	Mon 8/31/15	Fri 1/15/16
91	1.6.3.2.1.4	Design, procure, assemble light collection and light tighting	60 days	Mon 12/21/15	Fri 3/11/16



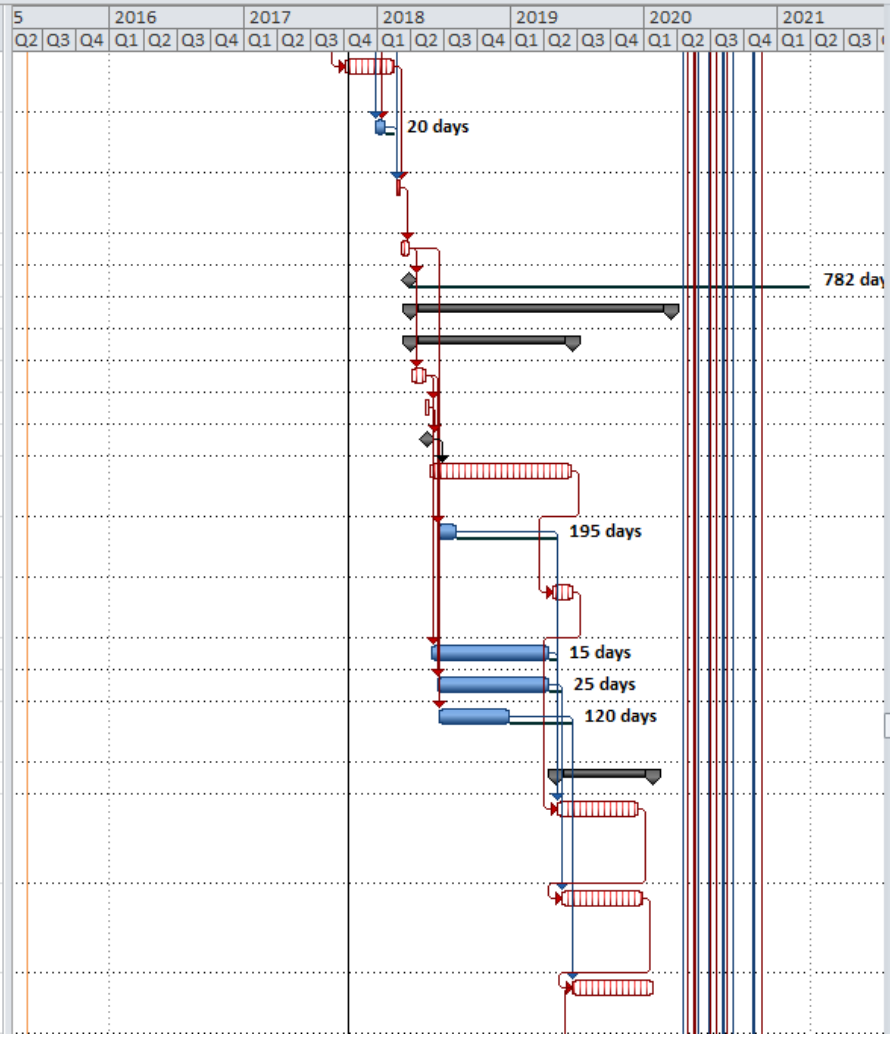
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
92	1.6.3.2.1.5	Design, procure, assemble stand	60 days	Mon 11/23/15	Fri 2/12/16
93	1.6.3.2.1.6	Integrate and test with electronics	20 days	Mon 3/14/16	Fri 4/8/16
94	1.6.3.2.1.7	Prepare and transport to test beam	10 days	Mon 3/14/16	Fri 3/25/16
95	1.6.3.2.1.8	Test beam operation	20 days	Mon 3/28/16	Fri 4/22/16
96	**1.6.3.2.2**	**Outer HCAL prototype v2**	**220 days**	**Mon 4/25/16**	**Fri 2/24/17**
97	1.6.3.2.2.1	Specify configuration	10 days	Mon 4/25/16	Fri 5/6/16
98	1.6.3.2.2.2	Design, procure, asemble absorber	100 days	Mon 5/9/16	Fri 9/23/16
99	1.6.3.2.2.3	Design, procure, asemble scintillator tiles	100 days	Mon 5/23/16	Fri 10/7/16
100	1.6.3.2.2.4	Design, procure, assemble light collection and light tighting	60 days	Mon 9/26/16	Fri 12/16/16
101	1.6.3.2.2.5	Design, procure, assemble stand	40 days	Mon 8/15/16	Fri 10/7/16
102	1.6.3.2.2.6	Integrate and test with electronics	20 days	Mon 12/19/16	Fri 1/13/17
103	1.6.3.2.2.7	Prepare and transport to test beam	10 days	Mon 1/16/17	Fri 1/27/17
104	1.6.3.2.2.8	Test beam operation	20 days	Mon 1/30/17	Fri 2/24/17
105	**1.6.3.2.3**	**Outer HCAL preproduction prototype**	**220 days**	**Mon 2/27/17**	**Fri 12/29/17**
106	1.6.3.2.3.1	Specify configuration	10 days	Mon 2/27/17	Fri 3/10/17
107	1.6.3.2.3.2	Design, procure, assemble absorber	140 days	Mon 3/13/17	Fri 9/22/17
108	1.6.3.2.3.3	Design, procure, asemble scintillator tiles	100 days	Mon 4/10/17	Fri 8/25/17
109	1.6.3.2.3.4	Design, procure, assemble light collection and light tighting	80 days	Mon 5/8/17	Fri 8/25/17



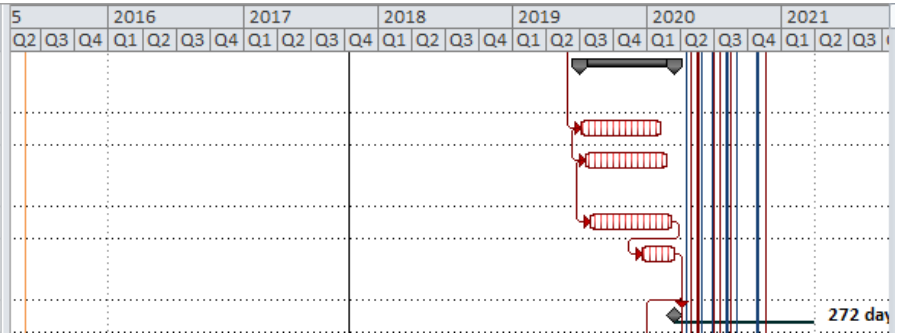
HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
110	1.6.3.2.3.5	Design, procure, assemble stand	100 days	Mon 7/3/17	Fri 11/17/17
111	1.6.3.2.3.6	Integrate and test with electronics	20 days	Mon 9/25/17	Fri 10/20/17
112	1.6.3.2.3.7	Prepare and transport to test beam	10 days	Mon 11/20/17	Fri 12/1/17
113	1.6.3.2.3.8	Test beam operation	20 days	Mon 12/4/17	Fri 12/29/17
114	1.6.3.2.3.9	Compete Outer HCAL Proto	0 days	Fri 12/29/17	Fri 12/29/17
115	**1.6.3.3**	**Outer HCAL production**	**510 days**	**Mon 1/1/18**	**Fri 12/13/19**
116	**1.6.3.3.1**	**Outer HCAL module productio**	**320 days**	**Mon 1/1/18**	**Fri 3/22/19**
117	1.6.3.3.1.7	Final Design	30 days	Mon 1/1/18	Fri 2/9/18
118	1.6.3.3.1.8	Final Design Review Outer H	5 days	Mon 2/12/18	Fri 2/16/18
119	1.6.3.3.1.9	Outer HCAL Design Complet	0 days	Fri 2/16/18	Fri 2/16/18
120	1.6.3.3.1.1	Procure absorber	280 days	Mon 2/19/18	Fri 3/15/19
121	1.6.3.3.1.2	Prepare factory and storage area	40 days	Mon 3/12/18	Fri 5/4/18
122	1.6.3.3.1.3	Receive absorber (early start of 2 mos)	45 days	Mon 1/21/19	Fri 3/22/19
123	1.6.3.3.1.4	Procure module hardware	230 days	Mon 2/26/18	Fri 1/11/19
124	1.6.3.3.1.5	Procure scintillator tiles	220 days	Mon 3/12/18	Fri 1/11/19
125	1.6.3.3.1.6	Procure light collector components	140 days	Mon 3/19/18	Fri 9/28/18
126	**1.6.3.3.2**	**Outer HCAL module assembly**	**190 days**	**Mon 2/4/19**	**Fri 10/25/19**
127	1.6.3.3.2.1	Absorber stacking (station 1) (1 week station to station)	160 days	Mon 2/4/19	Fri 9/13/19
128	1.6.3.3.2.2	Scintillator installation (station 2) changed duration to 160 days	160 days	Mon 2/18/19	Fri 9/27/19
129	1.6.3.3.2.3	Electronics and light tighting (station 3)	160 days	Mon 3/18/19	Fri 10/25/19



HCal Schedule with Critical Path

	WBS	Name	Duration	Start	Finish
130	**1.6.3.3.3**	**Outer HCAL module testing/calibration/integratior**	**185 days**	**Mon 4/1/19**	**Fri 12/13/19**
131	1.6.3.3.3.1	Electronics and sensor test	160 days	Mon 4/1/19	Fri 11/8/19
132	1.6.3.3.3.2	Light pulser/calibration test	160 days	Mon 4/15/19	Fri 11/22/19
133	1.6.3.3.3.3	Cosmic ray/source test	160 days	Mon 4/29/19	Fri 12/6/19
134	1.6.3.3.3.4	Prep module for transportation to 1008	65 days	Mon 9/16/19	Fri 12/13/19
135	1.6.3.3.3.15	Outer HCAL Ready for Instal	0 days	Fri 12/13/19	Fri 12/13/19



HCal WBS Dictionary - example

sPHENIX	01/26/2015	E. Kistenev, J. Lajoie, J. Haggerty

4. WBS Element Code	5. WBS Element Title
1.06.01.03.01	Inner HCAL module production

6. Index Line Number:	7. Revision Number and Authorization:	8: Rev. Date

9. Approved Changes

9. Element Task Description

COST CONTENT:
 	
TECHNICAL SCOPE:
 	
Inner HCAL module production consists of all activities needed to take the Inner HCAL design (completed under WBS item 1.06.01.01) and complete construction of 32 modules that can be delivered to the sPHENIX Assembly Hall for installation the detector. Since design activities will be complete, this WBS line captures the effort needed to actually produce the modules, including procurement of the absorber, procurement of any mechanical parts needed to assemble and strengthen the absorber into a rigid structure, and manufacture of any additional handling fixtures needed to construct the modules. Procurement and delivery of scintillator tiles with embedded WLS fiber designed under WBS 1.06.01.01 is contained in this WBS line, as well as production of any assemblies needed to couple the photodetectors to the scintillating tiles.
 	
WORK STATEMENT:
• Procurement and acceptance verification of parts needed to construct the Inner HCAL modules, including
  o Absorber plates
  o Scintillating tiles
  o Light collection hardware
  o Cable management hardware
• Preparation of workspaces need for assembly in Inner HCAL modules
• Preparation of any storage needed while modules await assembly

Tracking Review Recommendations

Date	Subproject	Recommendation	Status
3/28/2014	Calorimeters	The sPHENIX team should focus on determining as quickly as possible whether the tilted plate solution for W-SciFi can satisfy the performance requirements for the experiment, based on the recent test beam results and, if necessary, further simulations. If so, this should be the basis for developing the conceptual mechanical design, preliminary cost estimate, and next level of prototype. Every effort should be made to reduce the time for this final technology choice for EMCal, and the decision for configuration of the HCal should follow soon after. Simulation of the new configuration with the technology choice should be made available for further performance studies in heavy ion collisions.	**Complete**
3/28/2014	Calorimeters	The Collaboration should start immediately to identify the subsystem managers for the construction phase.	**Complete**

There were two Calorimeter-related recommendations from the March 2014 review:

1) Identify whether a tilted-plate tungsten-SciFi calorimeter will meet the sPHENIX EMCal performance requirements. **We've changed the EMCal technology to a W- resin Spacal design (not this review)**
2) Identify L2 managers for HCal. **John Lajoie**

Issues and Concerns

- **HCal Prototyping has to start as early as possible to meet planned Construction Completion. 2 prototypes and 1 preproduction typical for subsystem.**
- **Long Lead Time for large purchases: Steel for Outer HCal – 14 mos.**
- **HCal on Critical Path – start prototype work early and track within project**
- **Not a lot of schedule float in installation schedule**
  - **3 months commissioning time**
  - **Presumes a start to the 2021 run in January 2021, which has a big uncertainty**
- **Need to identify and reserve HCal assembly space beyond 1008 complex**

Back Up

Schedule Constraints

- Prototyping has to start as early as possible to meet planned Construction Completion. 2 prototypes and 1 preproduction typical for subsystem.
- Start Decommissioning 7/2016
- Long Lead Time for large purchases: Steel for Outer HCal – 14 mos.
- Sequential Installation of Subsystems
- HCal on Critical Path – start prototype work early and track within project.

sPHENIX is Built on the Foundation of PHENIX

sPHENIX is a major upgrade to the PHENIX experiment, built on $10M's of infrastructure assembled over twenty years

Existing:

- **Support buildings: Counting house, electronic rack room, Assembly Hall, IR, PS and service buildings, office space, meeting rooms, etc.**
- **Mechanical: rails, crane, shield wall, cooling**
- **Electrical: substation, transformers, power distribution, grounding**
- **Safety systems**
- **Data acquisition computing and networking**
- **Work areas**
- **Extensive gas pad, large dewars including 3k gallon LN_2, proximetry to RHIC cryo**
- **HVAC, environmental controls, high capacity ventilation**